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AUTHOR McClain, Gerald R.
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ABSTRACT

This Computer Graphics Laboratory houses an IBM 1130 computer, U.C.C. plotter, printer, card reader, two key punch machines, and seminar-type classroom furniture. A "General Drafting Graphics System" (GDGS) is used, based on repetitive use of basic coordinate and plot generating commands. The system is used by 12 institutions of higher education in Oklahoma. (Author/MLH)

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TITLE OF PAPER OKLAHOMA'S MOBILE COMPUTER GRAPHICS LABORATORY

NAME OF AUTHOR GERALD R. MCCLAIN

TITLE & ADDRESS OF AUTHOR ASSISTANT PROFESSOR
MECHANICAL DESIGN TECHNOLOGY
OKLAHOMA STATE UNIVERSITY
112 CRUTCHFIELD HALL
STILLWATER, OKLAHOMA 74074

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ABSTRACT

OKLAHOMA'S MOBILE COMPUTER GRAPHICS LABORATORY

Gerald R. McClain, Assistant Professor

Mechanical Design Technology

Oklahoma State University

This paper describes the development of Oklahoma's Mobile Computer Graphics Laboratory. This innovative program was sponsored and developed by the State Department for Vocational Technical Education. The laboratory houses an IBM 1130 computer, U.C.C. plotter, printer, card reader, 2 key punch machines and seminar type classroom furniture. A "General Drafting Graphics System" (GDGS), is used based on repetitive use of basic coordinate and plot generating commands. The system is used by 12 institutions in Oklahoma.

OKLAHOMA'S MOBILE COMPUTER GRAPHICS LABORATORY

Gerald R. McClain, Assistant Professor

Mechanical Design Technology, Oklahoma State University

Students majoring in drafting and design technology in Oklahoma's junior colleges and technical institutes now have available a course in computer graphics. This innovative program sponsored by the State Department of Vocational and Technical Education and certified by the American Institute for Design and Drafting has the objective of narrowing the technology gap between industry and education.

Vocational and Technical educators have, as one of their greatest tasks, the responsibility of keeping up to date with the many technological advancements in business and industry. One of the most difficult things for our educator to do is to keep the activities he directs in the classroom relative to the activities taking place in modern industry. Educators cannot allow the technological gap between what is going on in our schools and what is going on in industry to become very wide or, before we know it, our most recent graduates are obsolete before they can get on the job. This is the reason we no longer stress vacuum tube fundamentals in our electronics programs. This is the reason so much work has recently been done in the area of electro-mechanical technology, which has been described as an emerging technology; and this is the basic reason for the establishment of a computer graphics facility.

Computer graphics, too, is an emerging technology. Unfortunately, one of the inherent characteristics of an emerging technology is a lack of an accurate descriptive definition of the technology. When the technology becomes firmly established, it can be very explicitly defined, and it ceases to be an emerging technology. An established technology

has proven its worth and benefits to the industrial society, and is characterized by various divisions of labor required for its maintenance; the operatives who handle the production, the professionals who creatively and theoretically apply the technology and, the technicians who supports both.

We invision full blown educational programs specifically and exclusively for the purpose of training computer graphics technicians. But this is in the future. What we need now is an instructional program to introduce this emerging technology to our students currently studying to be technicians and technologists.

The idea of a mobile computer graphics laboratory came as a result of several events. First, in the summer of 1970, Oklahoma State University's Mechanical Design Technology program with the cooperation of the State Department of Vocational and Technical Education conducted a three-day computer graphics seminar for drafting and design teachers from throughout the state of Oklahoma. For the first time teachers became convinced that this technology was not going to replace and make obsolete the draftsman or designer, but it would be a tool for him to increase his output and decrease the amount of boring routine and repetitious work he had to do. Our teachers at this point became intensely interested in the technology and its possibilities and began to think about ways to get their students exposed to it.

Second, through our visitations with industrial advisory committees at about this same time we learned that industry had begun asking what our drafting and design students knew about computer programming, incremented plotters, digitizers and the like and also through our follow-up studies, we found that a few of our graduates had found themselves in jobs working with plotters, digitizers and computer equipment.

Third, during the 1970-71 school year the state department for Vocational Technical Education began getting equipment requisitions for plotters and other graphic equipment from the junior colleges. Almost all of our junior colleges and technical institutes have computers and our teachers were wanting plotters for them. The cost of the plotters being requested ranged from $4,200 to $16,000 each. It quickly became obvious that this activity could become very expensive and since there are over 12 drafting and design, and civil technology programs in the state, the price tag for equiping these programs could easily be $100,000.

It occurred to Vo-Tec that if a mobile unit could be acquired which would house a plotter, a small computer, and classroom furniture which could be shared by all the institutions almost all the disadvantages of each institution having their own plotter equipment could be overcome and almost all the advantages too, could be acquired. So in the summer of 1972, Vo-Tec received the house trailor in which they housed seminar type classroom furniture, a U.C.C. plotter, an IBM 1130 (8k) computer with a printer and card reader, and 2 keypunch machines. Vo-Tec also employed two people, a teacher who would travel throughout the state with the facility during that year to train teachers to use the system and a consultant for the summer only who had industrial experience in this area. The teacher and the consultant used the summer of 1972 to develop a flexible and efficient drafting programming language and to develop two sets of instructional materials: a system users manual and a combination text and workbook. The instructional materials written using measurable behavior objects were developed through the State Department's Curriculum and Instructional Materials Center.

Now it is possible for each institution to provide computer graphics instructions to their students. No institution will now have an expensive

piece of equipment receiving only limited use and being idle most of the time. Now each institution will have a trained teacher in this area and their students will use instructional materials which were heretofore nonexistent.

The computer graphics laboratory is being shared with 12 institutions. The first two years of operation approximately 3 weeks was spent at each institution. This last year we revised the schedule to 6 weeks at each institution every other year. This revision was necessary to cut down on travel cost and since each institution graduates students every two years the rescheduling still allowed all students to have computer graphics. The 6 week period is ample time for a one to three credit hour or equivalent mini course. Currently this instruction is being conducted as a part of existing courses or as special problems courses.

The general objectives of the computer graphics program are (1) to introduce the student to the computer as an analytical problem solving and graphics tool through the utilization of a problem oriented programming system that enables the student without prior computer experience to solve engineering related graphics problems and (2) to expose the student to a "hands-on" environment solving selected problems in drafting (civil, mechanical, electrical, architectural, etc.) which will involve interaction with the computer and the on-line incremental plotter for graphic output. The course outline is as follows:

I. Introduction to computer graphics
   A. Systems Philosophy
   B. Introduction to the IBM 1130 hardware & basic operations

II. Introduction to the "General Drafting Graphics System" (GDGS)
   A. Basic coordinate generating system applications

B. Basic plot generating system applications

III. System Applications

A. Utilization of GDGS in solving structural problems

B. Utilization of GDGS in solving student selected problems

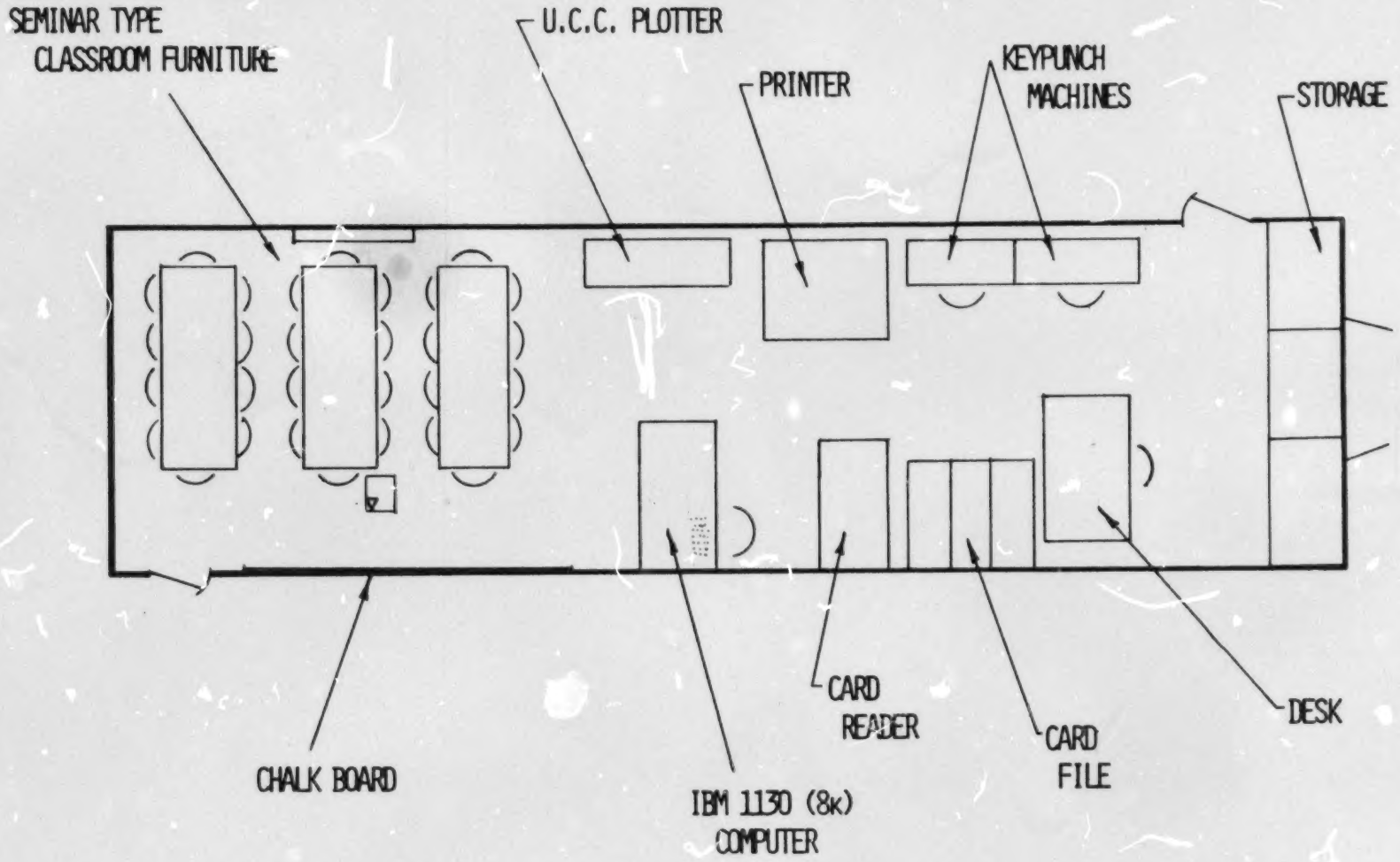
The "General Drafting Graphics System" (GDGS) is based on repetitive use of basic coordinate and plot generating commands. These commands are modular in construction and perform all basic operations within the system. All command modules interact with a common data storage area which contains all generated coordinate data stored under associated point members. This storage area is known as the "coordinate table" and provides the basic levels between coordinate generation and plot generation.

The operator uses the coordinate generation sub-system to generate coordinates with associated point members. Any reference to a specific coordinate need only be referenced by point member. These generated points may then be used to generate a plot using the plot generation sub-system's commands or dumped to cards for future use.

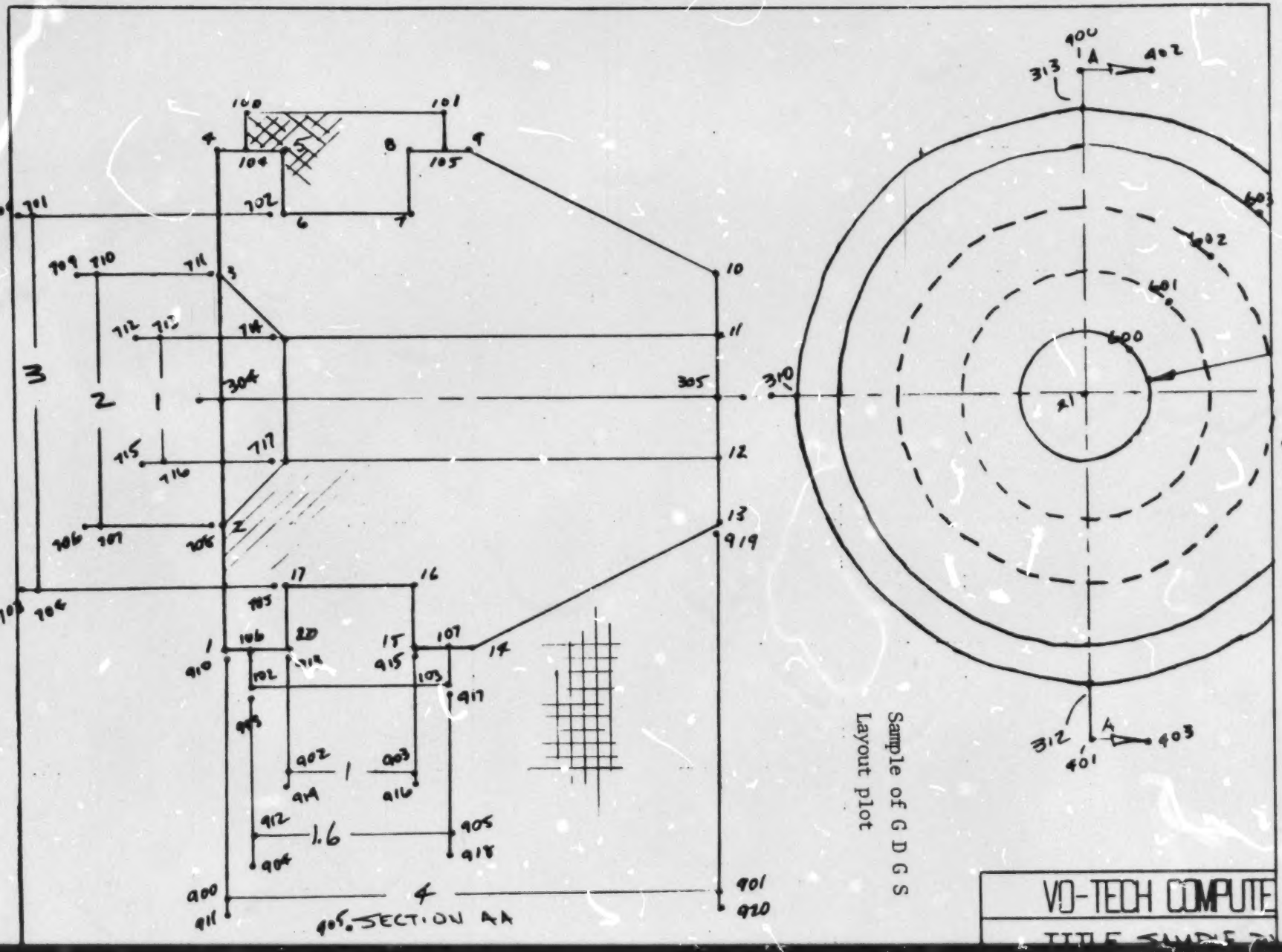
In actual practice GDGS constitutes a problem-oriented programming system which allows the technician to use the computer to generate computer graphic output using a "point number oriented" system. The prime feature of the system is its very general applications in the field of graphics and engineering technology.

The American Institute for Design and Drafting's certification program normally evaluates only complete curriculums, but do to the mobility of the Oklahoma Computer Graphics Laboratory and its innovative futuristic approach, AIDD's evaluation team extended certification to the Mobile Computer Graphics Laboratory.

Keeping up with the technology gap isn't easy, but putting a computer graphics classroom on wheels ought to keep Oklahoma in the running.



OKLAHOMAS MOBILE COMPUTER GRAPHICS LABORATORY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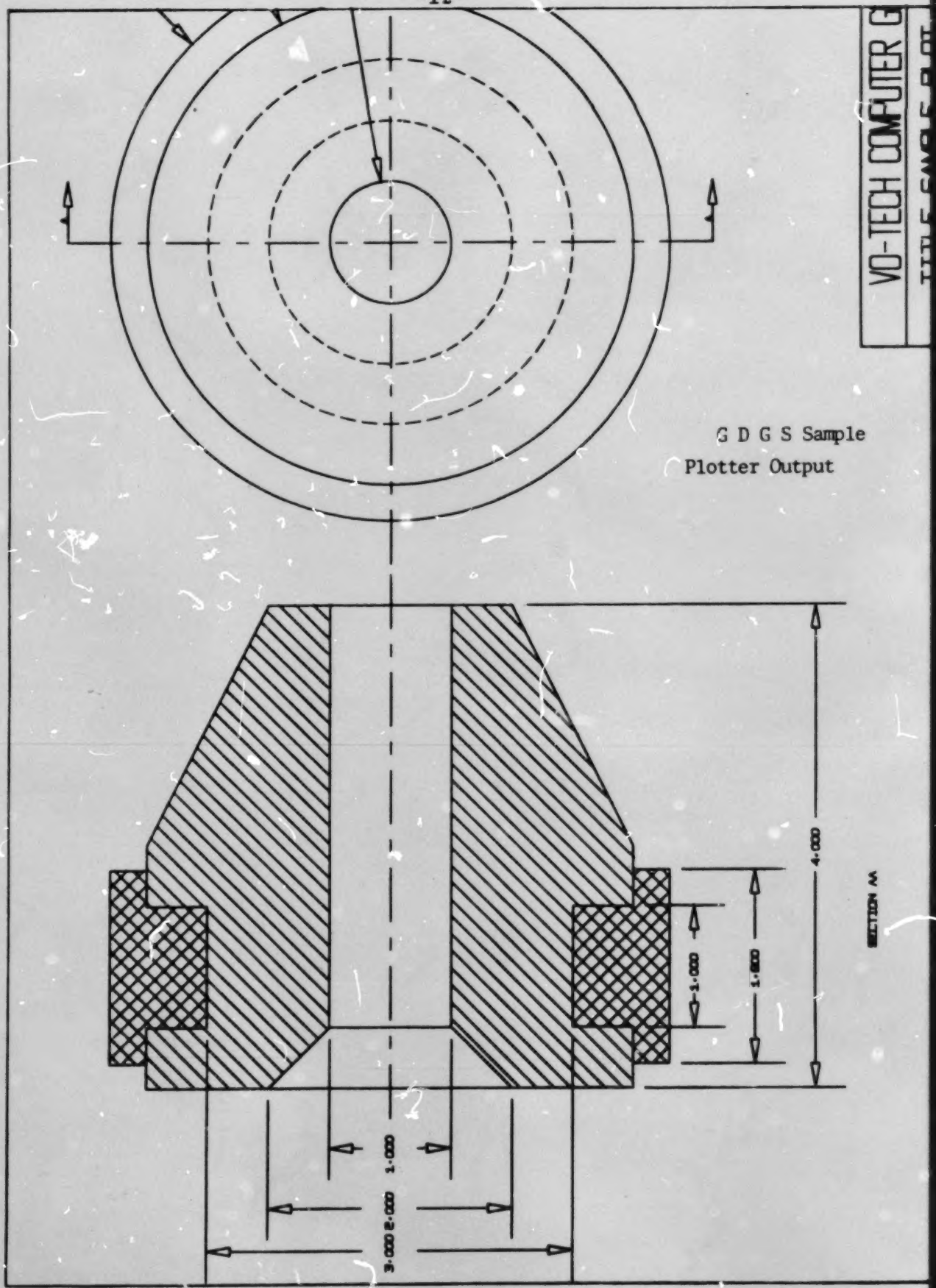
1.6
4
SECTION AA
Sample of G D G S
Layout plot
VO-TECH COMPUTE

G D G S Sample List of Input

```
// JOB
// XEQ GDGS      3
*LOCALCORE,ARCTT,PARL,INTSC,CIRCL
*LOCALDPLOT,DRAWL,DARC,HLINE,DCNTL,DIVL,ERRP,DNOTE,TBLOK,EADP,
*LOCALDREAD,SHADE,SHAD2
*CORD
$* JOB          SAMPLE PLOT   JONES  JULY 20, 1972
C      COORDINATE GENERATION
C      STORE REFERENCE POINTS
STORE          1 3 2
STORE          4 7 2
C      GENERATE FRONT VIEW OF OBJECT
LOC/LINE       1 4 2 1
LOC/LINE       1 4 3 3
LOC/PAR/LINE   1 4 0.5 20 5
LOC/PAR/LINE   1 4 1.0 15 8
LOC/PAR/LINE   1 4 2.0 14 9
LOC/PAR/LINE   20 15 -0.5 17 16
LOC/PAR/LINE   20 15 -3.5 6 7
LOC/PAR/LINE   2 3 4 13 10
LOC/LINE       20 17 18 1.5
LOC/LINE       20 17 19 2.5
LOC/PAR/LINE   18 19 3.5 12 11
C      GENERATE RIGHT SIDE VIEW OF OBJECT
LOC/LINE       1 2 304 2
LOC/ANGLE      1 304 21 7 -90 0 0.0
DEFINE/CIRCLE 600 21 600 0.5
DEFINE/CIRCLE 601 21 601 1.0
DEFINE/CIRCLE 602 21 602 1.5
DEFINE/CIRCLE 603 21 603 2.0
DEFINE/CIRCLE 604 21 604 2.3
LOC/LINE       1 20 106 0.2
LOC/LINE       1 20 107 1.8
LOC/PAR/LINE   106 107 0.3 102 103
LOC/PAR/LINE   106 107 -4.0 104 105
LOC/PAR/LINE   106 107 -4.3 100 101
C      GENERATE POINTS FOR CENTER LINES
LOC/LINE       304 21 305 4
LOC/LINE       304 21 310 4.7
LOC/LINE       304 21 311 9.3
LOC/ANGLE      304 21 312 2.3 -90 0 0.0
LOC/ANGLE      304 21 313 2.3 90 0 0.0
C      GENERATE POINTS FOR CUTTING PLANE LINE
STORE          405 1 3
LOC/LINE       21 313 400 2.65
LOC/ANGLE      21 400 402 0.5 -90 0 0.0
LOC/PAR/LINE   400 402 5.3 401 403
C      GENERATE DIMENSION LINE
LOC/PAR/LINE   2 13 2.5 900 901
LOC/PAR/LINE   20 15 0.5 902 903
LOC/PAR/LINE   102 103 0.7 904 905
LOC/LINE       2 1 910 1.1
LOC/LINE       2 1 911 2.75
LOC/LINE       106 102 993 0.4
LOC/LINE       106 102 912 1.25
LOC/LINE       17 20 913 0.6
```

G D G S Sample List of Output

```
/*****/ C O O R D I N A T E   G E N E R A T I O N   P H A S E /***
==========================================================================

$$ JOB          SAMPLE PLOT   JONES   JULY 20, 1972
C     COORDINATE GENERATION
C     STORE REFERENCE POINTS
STORE          1 3 2
      1                3.0000                    2.0000

STORE          4 7 2
      4                7.0000                    2.0000

C     GENERATE FRONT VIEW OF OBJECT
LOC/LINE       1 4 2 1
      2                4.0000                    2.0000

LOC/LINE       1 4 3 3
      3                6.0000                    2.0000

LOC/PAR/LINE   1 4 0.5 20 5
     20                3.0000                    2.5000

      5                7.0000                    2.5000

LOC/PAR/LINE   1 4 1.5 15 8
     15                3.0000                    3.5000

      8                7.0000                    3.5000

LOC/PAR/LINE   1 4 2.0 14 9
     14                3.0000                    4.0000

      9                7.0000                    4.0000

LOC/PAR/LINE   20 15 -0.5 17 16
     17                3.5000                    2.5000

     16                3.5000                    3.5000

LOC/PAR/LINE   20 15 -3.5 6 7
      6                6.5000                    2.5000

      7                6.5000                    3.5000

LOC/PAR/LINE   2 3 4 13 10
     13                4.0000                    6.0000

     10                6.0000                    6.0000

LOC/LINE       20 17 18 1.5
     18                4.5000                    2.5000

LOC/LINE       20 17 19 2.5
```


VO-TECH COMPUTER G
G D G S Sample
Plotter Output
4.000
1.000
1.000
1.000
2.000
3.000
SECTION AA